temperature fell at nearly the adiabatic rate for dry air. The state of stable equilibrium below the inversion point would probably tend to confine the greater part of the dust to a stratum of air of limited depth.

The morning weather map of January 15 showed a trough-shaped LOW extending from British Columbia to Kansas, with the lowest sea level pressure, 29.35 inches, at Helena, Mont. The pressure was also low, 29.2 inches, over the Gulf of St. Lawrence. Between the two LOWS was a ridge of relatively high pressure extending from east of Winnipeg to the Gulf of Mexico. Temperatures in this HIGH were low, ranging from −10° F. north of the Great Lakes to 40° F. along the eastern Gulf coast. Cheyenne, Sheridan, Rapid City, and Denver reported temperatures close to 50° F. with wind velocities between 20 and 34 miles an hour. Stations in Iowa reported zero temperatures. There was, therefore, a difference in temperature between the eastern and western stations of about 50 degrees.

Kansas and the eastern half of Nebraska had received precipitation within the preceding 48 hours. Undoubtedly the ground was wet for several hundred miles west and southwest of the station. This condition would prevent the formation of dust in the vicinity of Drexel. It is believed that the high wind drove the dust into the air somewhere along the eastern slope of the Rocky Mountains, probably in Colorado or Wyoming. The altitude of Denver, Colo., is about 1,200 meters greater than that of Drexel. As the warm air flowed east along the gradient of the LOW it moved into a region of lower temperature. This condition compelled the warm west wind to blow above the colder south wind without mixing with the latter. The dust cloud, therefore, passed over this station at practically the same altitude above sea level as that at which it originated.

Such a condition is often observed in the lower strata at this station in connection with smoke clouds. It usually occurs as the lower wind blows from an easterly direction immediately after the passage of a high pressure area. Smoke from the city of Omaha, about 20 miles east-southeast of Drexel, can then be seen moving toward the station in a thin sheet a few hundred meters above ground. Kite flights made under these conditions always show a temperature inversion from the ground to some altitude above the upper surface of the smoke.

FURTHER EVIDENCE AS TO THE WESTERN ORIGIN OF DUST WHICH FELL IN CENTRAL STATES, FEBRUARY 12–15, 1919.

In an article on "The Great Cyclone of Mid-February, 1919," in the October MONTHLY WEATHER REVIEW (pp. 582–586) there was a brief discussion of the character of the dust collected at Des Moines, Iowa, samples of which had been examined by Mr. Jacques W. Redway of Mount Vernon, N. Y. Since the publication of that article, Mr. Redway has written to the author telling of further examinations which he has made. He says, in part: "It was not until I had received the last of half a dozen samples that I was enabled to designate its character. The last sample, which was coarse, showed that the substance was magnetic oxide of iron, Fe_3O_4, and not metallic iron. In other samples the substance so closely resembled smeltery dust that I was deceived. The dust was very clearly from the Rocky Mountains." The article above referred to stated that it was probable that the small iron particles were of local origin, perhaps from foundries in the vicinity.—*C. L. M.*

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THE OBSERVATION OF DUST FALLS.

By ERIC R. MILLER.

[Presented before the American Meteorological Society, at Chicago, Dec. 28, 1920.]

[Author's abstract.]

Observation of the frequence and extent of dust falls and collection of the dust for examination are important services that the meteorologist can render the geologist, soil physicist, and plant pathologist.

Questionnaires sent out on the occasion of dust falls brought replies indicating that less than 10 per cent of the official and cooperative observers had noticed the dust.

This paper describes the appearance of rain and snow containing dust, and suggests methods of separating the dust without destroying living organisms, driving off volatile constituents, or contaminating the sample.

DISCOLORATION OF SNOW IN NORTHERN NEW YORK.

That the atmosphere in northern New York is very clean is proved by the pure whiteness of the snow, even after it has remained on the ground for a long time. At Alexandria Bay, where only hard coal is burned and there is no railroad closer than 6 miles and no factories closer than 30, there is no reason why the snow should be other than dazzling white. However, for all this, it has often come to my notice that there is a faint brownish tinge to the snows that come with the south and west winds when the temperature is near or a little above the freezing point, making a strong contrast with the extreme whiteness of the snows which are brought with the cold northerly and northeasterly winds. For instance, we will have a snow from the north, then a few days later there will be a rise in temperature with southerly or westerly winds, and with it snowfall. This snow has a dirty appearance as it lies upon the snow that fell before it. It is not always that snow with these winds is discolored. Is it not possible that the discoloration of the snow is due to the higher temperature at which it is formed? This brownish snow is generally in very large flakes and often mixed with snow pellets or soft hail (graupel), while the snow from the north is of finer texture and drier. As far as the eye can observe the brownish snow seems as clean as the other. I am curious to learn the cause of this phenomenon.—*Douglas F. Manning.*

DISCUSSION.

There would seem to be no reason to expect a difference in color on account of any difference in the crystals or the amount of water they may have. The most obvious explanation that suggests itself is that the smoke from the industrial cities south and southwest of Alexandria Bay makes the snow dirty, crystallization taking place perhaps directly on the smoke particles, and thus bringing them to the ground. On rare occasions the snow there may be discolored by dust carried from the Great Plains. A chemical analysis of this "dirty" snow would be interesting, and would reveal the cause of its discoloration.—EDITOR.

NOTE IN REGARD TO THE CLINGING QUALITIES OF SNOW.

Other things being equal, the clinging quality of snow will depend upon the form of the snowflake. This was exemplified at Binghamton, N. Y., on February 11, 1921.

The snow fell gently, without wind, from about 8:30 p. m. of the 10th to during night a. m. of the 12th, but the major portion of the snow had fallen by 8 a. m. of the 11th, and even the smallest twigs held a goodly share. Spaces as wide as 10 inches were bridged across and bunches of snow remained in the trees for three days. The weight of the snow, however, was small and little damage was done. No limbs of trees were broken, but a few electric wires came down. Country roads were not blocked to automobiles.

During the fall of snow the temperature remained steadily at 32° F.

The quite unusual clinging quality of the snow was due to the fact that the crystals were straight, fuzzy rods averaging about one-sixteenth inch in length and these, on reaching a suitable support, clung together, forming a tenacious blanket.—*John R. Weeks.*

SNOW ROLLERS.

AVON, N. Y., *February 9.*—When Peter Finigin went out to do the chores one morning recently he was mystified by the sight of a large number of huge snowballs scattered over his farm. On the 20-acre field there were hundreds of them, ranging in size from 6 to 18 inches in diameter. Leading up to each snowball was a streak of bare ground showing the distance it had traveled in forming.

Mr. Finigin and neighbors who gathered to study the odd spectacle decided that the wind, which had blown a gale the night before, had whipped up small particles of "good packing" snow and started them down the field, some of the particles gathering up additional snow until balls had been formed that were too heavy for the wind to move farther. All the paths of the snowballs were in the same general direction that the wind had been blowing.

To record the unusual freak of wind and snow, Mr. Finigin sent for the correspondent of a Buffalo newspaper, who counted more than 1,000 snowballs of more than 10 inches in diameter.—*Washington Evening Star,* Feb. 9, 1921.

BIBLIOGRAPHIC NOTE.[1]

* * * The most extensive account of snow rollers in the English language is that given in the *Quarterly Journal* of the Royal Meteorological Society, volume 34, 1908, pages 87–96. This is mainly a compilation of accounts of the phenomenon previously published in scientific books and journals, and is illustrated. Some of these accounts appeared in the MONTHLY WEATHER REVIEW.[2]

Probably the most important contribution to the subject of snow rollers is the article, "Schneewalzen," by Rudolf Meyer, in Korrespondenzblatt des Naturforscher-Vereins zu Riga, volume 52, 1909. This gives a list and analysis of all cases known to the writer between the years 1808 and 1909, and is accompanied by a bibliography which lists 35 previous papers on the subject in several languages.

Snow rollers were observed in Morris County, N. J., in January, 1809, by Rev. D. A. Clark, when it is stated that "the whole landscape was covered with snowballs, differing in size from that of a lady's muff to the diameter of 2½ or 3 feet, hollow at each end to almost the very center, and all as true as so many logs shaped in a lathe."—*C. Fitzhugh Talman.*

[1] Reprinted from *Scientific American,* New York, Mar. 15, 1913, p. 243.
[2] Dec., 1895, 23:465; Jan., 1898, 26:20; Mar., 1899, 27:100; July, 1906, 34:325–326; Feb., 1907, 35:70.

OUR INVOLUNTARY CLIMATIC TRAVELS.

(WITH SPECIAL REFERENCE TO THE WARM WINTER OF 1920-21.)

551.58 (73)

By JOSEPH BURTON KINCER, Meteorologist.

[Weather Bureau, Washington, D. C., Mar. 2, 1921.]

The temperature of the atmosphere to which we are subjected, from day to day, plays an important rôle in our everyday life, particularly in so far as our bodily comfort when we are out of doors is concerned. Most of us do not relish extreme temperature conditions, and a considerable portion of our energy is expended in an effort to keep cool in hot, summer weather, and to keep warm when it is cold.

To escape the extreme temperature conditions of winter and summer, many people migrate yearly from north to south in winter and from south to north in summer. In northern latitudes they turn southward as the rigors of winter set in to sojourn until the gentle zephyrs of spring are due in their home community. Again, when the heat of summer begins in central and southern climes, all roads lead to some cool summer resort.

While some people thus bodily change their place of residence to enjoy climatic environments different from those usually experienced at home, many others, and much the greater portion of our population, either for reasons of choice, or for those beyond their control, stay at home. These latter, however, practically never stay at home climatically. They travel regardless of the press of business or the condition of their purse, but are not affected by increased railway or Pullman fares, for the figurative weather train furnishes free passage.

We are often handicapped, however, by reason of the fact that the science of meteorology has not, as yet, reached that degree of excellence where it is possible to forecast, with approximate certainty, in which direction, north or south, we will be transported to spend the season. To this end, however, the Weather Bureau is engaged in scientific investigations, to ascertain if seasonal schedules can be made. If this can be done our plans can be made accordingly, often at great economic advantage.

While we can not yet tell definitely in advance where our climatic season abode shall be, after we have enjoyed or deplored our involuntary weather trip, and have spent the winter or the summer either north or south of home, climatically, we can then consult the Weather Bureau records and determine just where we have been.

Such expressions as "It wasn't necessary to go to Florida this winter to enjoy a pleasant climate, for the weather here has been delightful" have been frequently heard recently. These suggest the questions, "How far south, from the standpoint of climate, did we really spend the winter just closed?" "Did we go as far south this winter as in some previous years?" "What is the farthest point south we have ever climatically spent a winter?" The answers to these and similar questions with regard to the summer season may be of interest, especially to those who have never given much thought to the fact that a